

Secondary Cosmic Ray detection with RPCs: a state-of-art review and possible applications in Space Weather studies

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Cosmic Ray Detection

UHECR

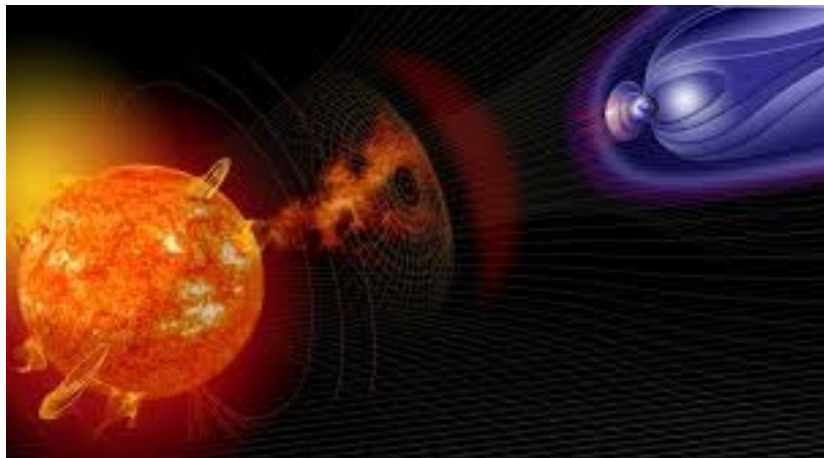
- Very High Energy Cosmic Rays (VHECR) research has various interesting questions open about their origin and composition



Cosmic Ray Detection

Space Weather

- Through the detection of CR we can study the influence of the Sun, solar wind etc in our planet



A full coverage EAS detector

Detector characteristics

- 1836 single layer RPCs with 93% active area surrounded with $\approx 20\%$ guard ring
- 153 clusters of 12 RPCs each
- two independent readout systems: each RPC is simultaneously read-out by 80 copper strips ($6.75 \times 61.80 \text{ cm}^2$) logically arranged in 10 independent pads ($55.661.8 \text{ cm}^2$) and by two large pads called Big Pads ($139 \times 123 \text{ cm}^2$).



Enhancing CR detection capabilities

Detector characteristics

- dense sampling for a very low energy threshold (≈ 100 GeV)
- wide energy range: ≈ 100 GeV to ≈ 10 PeV, to open the PeV range to γ -ray astronomy and to study classical CR physics
- high granularity of the read-out to have good angular resolution, good energy resolution and unprecedented details in the sampling of the temporal profile to improve the background rejection below the TeV.



Muon Auger RPC for the Tank Array MARTA

Detector characteristics

- A 1.2 x 1.5 m area detector with 64 channels
- Designed for low cost operation (low gas flow)
- WCD absorbs EM component therefore RPC detect only muons



A non-central CR detector array

Detector characteristics

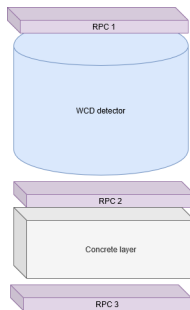
- Each telescope is composed by three MRPCs
- AVME-based data acquisition includes a trigger card, 144 TDC channels and a GPS unit for remote synchronization
- More than 50 Muon telescopes installed over Italy



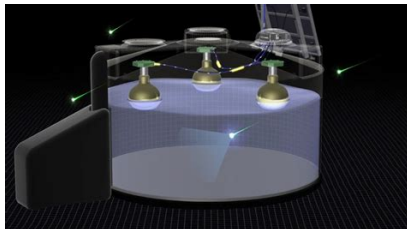
An Hybrid detector

WCD plus RPC

- Combining WCD and RPC detectors to create a CR Detector
- 3 RPCs plus a WCD
- Depending on detector settings and location several Physics studies can be done



- The LAGO (Latin American Giant Observatory) project is an extended Astroparticle Observatory at global scale. It is mainly oriented to basic research on three branches of Astroparticle physics: the Extreme Universe, Space Weather phenomena, and Atmospheric Radiation at ground level.
- Low cost WCD detectors are already installed along S.A.
- Adding RPCs will improve CR detection capabilities



- **Main Goal:** To modernise the educational platform in **eight Latin-American Higher Education Institutions (HEI)** from the Andean region using *High Energy Physics (HEP)* as a model.
- **How to do it?** To create a **Virtual Community dedicated to Education and Research** implementing a 1 year specialization in HEP to integrate with Master degree programs
 - Open access *e-learning* platform
 - Fundamental and Advanced laboratories in each HEI
 - Flexible problem solving oriented syllabus
 - Hands-on experiences and internships



Conclusions

- RPCs together with WCD will create a hybrid CR detector
- Opportunities to develop low-cost RPCs detectors are open
- Latin America is gaining momentum in HEP
- Collaboration between Europe and Latin America can foster the growth of HEP community





THANKS FOR
STAYING
AWAKE
DURING THIS
PRESENTATION

